

MAGNETIC BEARING ELEMENT

The invention relates to a magnetic bearing element having at least one annular permanent magnet that is surrounded by an annular binding band.

5 Magnetic bearing elements of this kind for magnetic bearing arrangements are known. The document DE 38 08 331 C2 discloses a magnetic bearing that comprises two self-contained bearing components: a stabilization bearing and a center-of-gravity bearing. This non-contact bearing system is implemented using annular permanent magnets and at least one further set of magnet rings that have an axial magnetization
10 opposite to that of the first set. Such bearing arrangements are used predominantly in machines that are operated at very high rotation speeds, for example turbomolecular pumps or flywheels.

 To prevent the annular permanent magnets of the stabilization bearing from expanding, as a result of the large centrifugal forces occurring at high rotation speeds,
15 to such an extent that the fits existing between the magnets become lost and the magnets burst (or shift in the axial direction and detach from the hub), concentric binding bands made of high-strength non-magnetic material having a high tensile strength, preferably a carbon-fiber material with a high tangential preload, are mounted from outside onto the annular permanent magnets during assembly of the bearing
20 elements. These binding bands exert large, inwardly directed radial forces on the annular permanent magnets, counteracting the centrifugal forces that occur during operation.

 A substantial disadvantage is the fact that much of the binding band preload is required simply to close the radial gaps between the concentric magnets, and between
25 the inner magnets and the rotor hub. The extremely large centrifugal forces occurring at very high rotation speed can cause the permissible tensile stresses in the binding band, and the permissible compressive stress in the magnet material, to be exceeded. The consequence is that either the binding bands or the annular permanent magnets are destroyed.

It is therefore the object of the invention to make available a magnetic bearing element that requires a lower preloading of the binding bands in order to close the gaps between the permanent magnets.

5 This object is achieved, according to the present invention, in that the respective permanent magnet is divided at at least one location and spaced apart there. The tangential supporting force occurring in an undivided permanent magnet is eliminated by this division. The divided permanent magnet can, as a result, be impinged upon by the binding band with a substantially lower pressure in order to overcome the gaps. The
10 consequence is either that substantially larger centrifugal forces can act on the permanent magnets without causing the latter to expand and detach from the hub or to shift axially, or that the preload can be made smaller, thus reducing the risk of destruction of the binding band or the magnet.

The necessary binding band preload can be made even smaller if the permanent
15 magnet is divided and spaced apart at multiple locations. The division can also be embodied as a radially extending slit.

If the division locations are distributed regularly over the periphery of the permanent magnet, a homogeneous distribution of the force acting on the permanent magnets as a result of the binding band preload is achieved. Impermissible bending
20 stresses in the magnet rings are also avoided.

In a manner known per se, the bearing element can comprise multiple permanent magnets arranged concentrically with one another, all of which are divided at at least one location and spaced apart there. Here as well, the tangential supporting force that occurs in permanent magnets embodied without a slit is eliminated. The
25 binding band preload needed to produce an immovable compressive contact between the enveloping surfaces of the individual permanent magnets can, as a result, be made smaller.

When multiple permanent magnets arranged concentrically with one another are provided, the locations at which the permanent magnets are divided are
30 advantageously offset from one another in the circumferential direction. The result is

that bearing stability is further enhanced, the force acting on the magnets as a result of the preload is homogeneously distributed, and assembly is simplified.

Advantageous embodiments of the invention are disclosed in the dependent claims and in the description below of the drawings.

5 The invention is illustrated in more detail, with reference to an exemplifying embodiment, in the Figure, which is a cross section through the magnetic bearing element according to the present invention. A hub 1 is surrounded by an annular magnet 2 that comprises radially extending slits 4 offset 90 degrees from one another. Adjoining this annular magnet 2, which is split into four segments, is a further annular
10 magnet 3. The latter is likewise split into four segments by four radially extending slits 4 offset 90 degrees from one another. Slits 4 of annular magnet 3 are arranged with an offset of 45 degrees from slits 4 of annular magnet 2. A binding band 5 is mounted onto annular magnets 2, 3 and hub 1 with a preload, ensuring that annular magnets 2, 3, as
15 inwardly directed force.